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ABBREVIATIONS AND SYMBOLS

a	Consistency parameter in power law ($Pa \cdot s^n$)
A	Matrix representing the complete relationship between FR_s and DP_s
A_i	Defined area of the SEM image
C	Constant that equals to 1.0 when the property is modulus and equals to 0.3 when it is the collapse stress
C_0 *and* C_1	Concentrations of homogeneous nucleation sites and heterogeneous nucleation sites, respectively
Cs	Solubility of gas in the polymer (cm^3/g) or ($g_{gas}/g_{polymer}$)
d	Average cell size
dp/dt	Pressure drop rate (Pa/s)
D	Diffusion coefficient or diffusivity (cm^2/s)
D_0	Material dependent diffusion coefficient
DP_s	Design parameters
E_D	Activation energy in diffusion
f_0 and f_1	Frequency factors of gas molecules joining the nucleus (l/s) for homogeneous nucleation and heterogeneous nucleation, respectively
FR_s	Functional requirements
H	Henry's law constant (cm^3 [STP]/g-Pa)
H_0	Solubility coefficient constant (cm^3 [STP]/g-Pa)

HMS	High-melt-strength
k	Boltzman's constant (J/K)
l	Diffusion distance
L^2	Defined area ($L \times L$) of the SEM image
L_{die}	length of the nozzle
m	Mass of the gas molecule
m_{air}	Mass of the sample measured in the air
m_p	Mass flow rate of material (g/min)
m_{water}	Mass of the sample measured in distilled water
m_{gas}	Mass flow rate of gas (g/min)
M	Magnification factor of the image
M_t	Mass uptake of the sample at time (t); (g)
M_∞	Equilibrium mass uptake after an infinite time (g)
n	Degree of polymerization
n_1	Number of moles of solvent
n	Number of bubbles or cells
N_0 and N_1	Homogeneous and heterogeneous bubble nucleation
N_0	Cell density (cells/cm^3)
P	Property of the bulk polymer
P_c	Critical pressure
P_f	Property of the foamed sample
P_i	Pressure inside the critical bubble
P_s	Pressure of the surrounding the bubble
P_{die}	Die pressure (Ps/s)

$P_{solubility}$	Solubility pressure of blowing agent (gas)
p	Characteristic of the material = 2100 N-s$^{0.51}$/m^2
q	Characteristic of the material = 0.51
Q	Volume flow rate of the polymer/gas solution
r	Critical radius of the bubble
r_1 and r_2	Radius of bubble 1 and 2, respectively
R	Ideal gas constant (J/K)
R_{die}	Radius of the nozzle
$S(\theta)$	Function depending only on the wetting angle θ of the particle-gas interface
t	absorption time (s)
t_D	Time required for the completion of absorption (s)
t_s	Elapse time (s)
$t_{residence}$	Average residence time
T	Temperature in Kelvin (K)
T_c	Critical temperature (°C)
T_c	Crystallization temperature (°C)
T_g	Glass transition temperature (°C)
T_m	Melting temperature or crystalline transition temperature (°C)
v	Molar volume of the solvent
v_a	Expansion ratio of the sample
v_p	Specific volume of a material at room temperature
v_{gas}	Specific volume of blowing agent at the crystallization

V_f	Void fraction
x_1	Number of segment in the solvent molecule
z	Exponential equals 2 and 3/2 for the modulus and collapse stress
δ_1 and δ_2	Solubility parameters of solvent and polymer, respectively
ϕ_1 and ϕ_2	Volume fractions of solvent and polymer, respectively
ρ	Density of the un-foamed sample
ρ_f and ρ_{water}	Densities of the foamed sample and the water, respectively
χ	Flory-Huggins interaction parameter
η	Blowing agent efficiency
σ	Surface tension
ΔE_{mix}	Internal energy change upon isothermal evaporation of saturated liquid to the ideal gas state at infinite dilution
ΔG_{mix}	Total Gibb's free energy of mixing
ΔG_{homo}	Critical free energy to form a nucleus of critical size for homogeneous nucleation
ΔG_{het}	Critical free energy to form a nucleus of critical size for heterogeneous nucleation
ΔH_c	Enthalpy change of crystallization
ΔH_m	Enthalpy change of melting
ΔH_m^*	Enthalpy change of melting of the theoretical 100 % crystalline polymer
ΔS_{mix}	Entropy of mixing